(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

(11) Publication number: **11295106 A**

(43) Date of publication of application: **29.10.99**

(51) Int. Cl **G01D 5/36**
G01L 3/10

(21) Application number: **10119964**

(22) Date of filing: **14.04.98**

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(54) TORQUE SENSOR FOR ELASTIC COUPLING

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a torque sensor for an elastic coupling capable of a pulse- type display for easily displaying the detection displacement itself by constituting a displacement detection transmitting means on the rotating body side so as to be easily fitted to the outside of the coupling with regard to the elastic coupling of a Hook's characteristic, and constituting the above displacement detection transmitting means with low-cost equipment and materials.

SOLUTION: A torque sensor is made up of a displacement detection transmitting means 26 and an arithmetic display part 27; and the detection signal detected by the displacement detection transmitting means 26 is input into the arithmetic display part 27 to arithmetically display the torque of the rotational system and the power of the transmitting shaft, and the displacement detection transmitting means 26 is made up of displacement graduations 15, displacement-indicating lines 16, photosensors 17, 18 for reading the graduations, and a cylindrical lens 19 for magnifying the displacement graduations 15.

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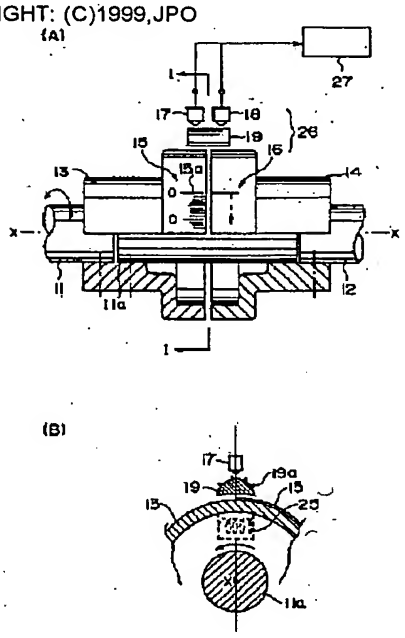


DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the torque sensor of elastic distributor shaft coupling (it is henceforth called elastic distributor shaft coupling) with the hook property combined through the elastic member which deforms according to a load, and it relates to the torque sensor for elastic distributor shaft couplings which made the dial plate and the index outside the structure which can be attached easily, without disassembling the distributor shaft coupling concerned for the displacement detection dispatch means at the time of the load of this distributor shaft coupling especially.
[0002]
[Description of the Prior Art] It is made the composition which that in which, as for a mechanical cable type, a magnetostriction formula, a variable-resistance formula, a variable-inductance formula, optical, etc., the torque detector currently used from the former has each advantages and disadvantages is developed and used, and most is planned as a measurement special-purpose machinery, for example, is installed between power transfer shafts at the time of use. For the structure of carrying out insertion mediation of the aforementioned detector in the measurement which uses them between a original working side and right-and-left both the shafts by the side of a follower, the most is [easy] complicated, it is, when [which are a original working side and a related equipment by the side of a follower] not attaching, installing and it is obliged to change of a position, and the signal sender by the side of body of revolution is installed, and expansion of area is [sender] also in it so that it may not be attached later.
[0003] Moreover, in order to make the conventional torque detector intervene between the shafts of a power shaft as mentioned above, it needs to select torque capacity and a rotational frequency suitably in the use. That is, although the nominal torque of a rotating machine is known, the size of change torque is strange in many cases, and it cannot but depend on presumption after all, and selection of the model of torque detector will invite the situation unreproducible [the damage on a torque detector or unreproducible], if this is mistaken. Moreover, in order to make it intervene between the shafts of a power shaft in installation, when an operating rotational frequency is large, in the lubricous method of the bearing of a detector, resonance of a shaft, a kind of distributor shaft coupling, selection of a weight accompanying it, etc., a complicated problem intervenes variously.
[0004] That is, although distributor shaft coupling which combines two shafts is the distributor shaft coupling itself, and a torque sensor is a sensor only for measurement, and it is distributor shaft coupling when the function of a torque sensor is given to distributor shaft coupling, it is also a torque sensor.
[0005]
[Problem(s) to be Solved by the Invention] this invention was made in view of the above-mentioned trouble, only sticks a pointer scale, or engraves those graduations, without performing reconstruction and processing for elastic distributor shaft coupling which has a hook property fundamentally, and it aims at offer of the torque sensor for elastic distributor shaft couplings which has the function in which measurement of the bias angle at the time of rotation, torque, and transfer power is performed to these by the sensor side of non-contact nature.
[0006] At least, in torque generating, the bias angle ("gap") which is the distortion carries out intensive generating in contact with distributor shaft coupling which is a original ** side joint at least, and sets elastic distributor shaft coupling as the object at a follower side at distributor shaft coupling which combines the rotating machine by the side of original **, and a follower side load. Moreover, the object of torque detection detects the bias angle which is "a gap"

which appears in the distributor-shaft-coupling front face by the side of original ** resulting from torque generating, and a follower directly.
[0007] Moreover, let the above-mentioned distributor shaft coupling be elastic distributor shaft coupling with a hook property.
[0008] moreover, the variation rate by the side of body of revolution -- a detection dispatch means -- the exterior of the distributor shaft coupling concerned -- easy -- the composition which can be attached -- carrying out -- the above -- a variation rate -- what constituted the detection dispatch means with the equipment of a low cost -- it is -- detection -- a variation rate -- the very thing considers as the composition which can be displayed and in which a pulse formula transcription is possible easily
[0009] Next, by the 1st method of measuring the relative angle of anomaly of two shafts with which the load of this application was applied, it is the method of reading directly the number of graduations prepared in body of revolution by the photo detector, and by the 2nd method, the pulse number which the light source which multiplied with the frequency-multiplication circuit emits within the angle of an angle of anomaly is read by the photo detector, resolution is raised, and highly precise measurement is performed.
[0010]
[Means for Solving the Problem] Therefore, the torque sensor for elastic distributor shaft couplings of this invention In the torque sensor which detects the displacement angle of the relative position of distributor shaft coupling which carries out elastic combination, and indicates torque and the transfer shaft power by the operation The displacement graduation which follows original working-side distributor shaft coupling at the time of a no-load at the criteria index line which is a zero graduation line, and it is formed. The original working-side sensor which prepared the displacement index line in the installation position of the aforementioned criteria index line at follower side distributor shaft coupling, and was formed in the upper part of the index line of these two groups, respectively, It is characterized by what was constituted from a displacement detection dispatch means considered as the composition containing a follower side sensor, a displacement detection means to control the graduation read of the aforementioned field working-side sensor and follower side NSA, and to detect a displacement angle, and an operation display which calculates torque and a transfer shaft power with a detection value.
[0011] Moreover, a detection means according to claim 1 makes the read of a original working-side sensor start by criteria index-line passage which is the zero graduation line of a displacement graduation, and is characterized by what was considered as the composition which stops the aforementioned read of a original working-side sensor by the read output of displacement index-line passage of a follower side sensor.
[0012] Moreover, a original working-side sensor according to claim 1 forms two or more fragmentation graduations in the projection side of a pillar-like lens, forms two or more individual sensors which read this fragmentation graduation on each subdivided graduation line, and is characterized by what the resolution-enhancement sensor was constituted for.
[0013] Moreover, other methods of angle-of-anomaly read are thetamin or its radii length Lmin about the minimum graduation angle which a sensor can read and discriminate to 1 graduation under rotation to the aforementioned case. In order to solve and to raise resolution more than this further, It is characterized by constituting so that the pulse number in the angle of anomaly which formed rate of division 1/sigma of 1 graduation, i.e., resolution, by the pulse frequency sigma Doubled from the electrical circuit, and produced the source of pulsed light of the light emitting device of a sensor by the load may be measured for every rotation, without being based on optical system.
[0014]
[Function] Therefore, according to the 1st method about the torque sensor for elastic distributor shaft couplings of this invention The displacement graduation which follows the

criteria index line which is a zero graduation, and it at the periphery is formed in original working-side distributor shaft coupling at the time of a no-load. Since it installs in follower distributor shaft coupling at the aforementioned criteria index line, the displacement index line is prepared and this photosensor for graduation read is prepared in the original working side and the follower side, respectively, The read work through the above-mentioned photosensor which carries out the conformity operation of the "angle of anomaly" corresponding to the torque generated with the load at a displacement detection means can detect, and torque and the transfer shaft power are indicated by the operation with this detection value.

[0015] without it appeals to the large-scale reconstruction means to established distributor shaft coupling thus -- only -- the stamp of a graduation -- or the work which sticks a graduation form -- a variation rate -- the variation rate following the zero graduation which are the index line and the criteria index line -- forming a graduation and only preparing this photosensor for graduation read -- the variation rate of a low cost -- a detection dispatch means can be attached easily and elastic universality distributor shaft coupling with a hook property can be provided with the torque sensor whose installation was enabled easily

[0016] moreover, the composition of a detection means according to claim 2 -- the torque of the rotation system concerned -- a fixed relative angle of anomaly -- with, the variation rate containing the criteria index line by which load operation is carried out -- a graduation and a variation rate, if a original working side and a follower side sensor are operated to the index line a original working-side sensor -- the variation rate from passage of a zero graduation -- the variation rate start the read of a graduation and according to a follower side sensor -- the read output of index-line passage -- the above -- a variation rate -- the read is stopped in the place which ended the read by which the read of a graduation is equivalent to a "angle of anomaly" the time of a no-load -- the above -- a variation rate -- the variation rate which are the index line and the criteria index line -- the variation rate which stopped the above-mentioned read since the zero graduation line of a graduation had prepared so that it may be in agreement on the same rotation angle -- the amount of graduations of a graduation is equivalent to the "angle of anomaly" of the rotation system concerned, and it can detect as "an amount of angles of anomaly"

[0017] Moreover, since the pillar-like lens for expansion is prepared in the upper part of a displacement graduation, two or more fragmentation graduations are formed in a projection side and this photosensor for graduation read is prepared on each fragmentation graduation by composition of a original working-side sensor according to claim 3, it means putting two or more fragmentation graduations into each graduation of a displacement graduation, and improvement in resolution can be aimed at.

[0018] Moreover, the pulse frequency which sets the rate of division of 1 graduation under rotation to 1/sigma by the publication of the claim 4 which is equivalent to the 2nd method of this invention the central angle of 1 graduation -- thetamin ** -- the graduation total minced by the distributor-shaft-coupling periphery concerned by the pulse to carry out (2pi)/thetamin It becomes, and n, then its pulse number are set to [(2pi)/thetamin] xn in a rotational frequency, and it is rate of division 1 aforementioned/sigma further. If it considers, the above-mentioned pulse number will be [(2pi)/thetamin] x nxsigma. It becomes. Here, rate of division 1 / sigma of 1 graduation for gathering cracking severity can be doubled in a frequency-multiplication circuit.

[0019] That is, this is a difference circuit by extraction of the higher harmonic from a nonlinear wave, or the nonlinear wave and alignment wave type bridge, and other known circuits, and can make it generate easily. Two lines, the criteria index line on distributor shaft coupling and the displacement index line, are irradiated to this as a source of pulsed light of a light emitting device. A photo detector starts criteria index-line read for the pulse of the aforementioned light emitting device for every rotation. a variation rate -- the read is stopped

by the index line, the pulse number which the photo detector read in the meantime becomes twice [to the identifiable minimum graduation / sigma] fundamental frequency, resolution is raised so much, and the relative angle of anomaly of two shafts or the radii length to this is measured with high precision

[0020] That is, at a claim 1, the relative shift of two shafts reads the number of graduations between the criteria index line and the displacement index line, and by the claim 4, if the luminescence pulse number between the both line is read by the photo detector, it reads with a start stage and an end stage is set up, an angle in the meantime will become the relative angle of anomaly theta of two shafts. in this case, the pulse number measured from the light source side -- P, then P -- the above-mentioned frequency-multiplication circuit -- the twice [sigma] as many source of pulsed light as this -- becoming -- [(2pi)/thetamin] x nxsigma A pulse number counts and the pulse number of ****** [(2pi)/thetamin] xsigma counts this by n to one rotation. That is, it becomes theta=P / (2 pixsigma/theta min) =Px(thetamin / 2pi) x (1/sigma), and, as for resolution, only 1/sigma will be high-degree-of-accuracy-ized.

[0021]

[Embodiments of the Invention] Hereafter, this invention is explained in detail using the example shown in drawing. However, the size of the component part indicated by this example, the quality of the material, a configuration, its relative configuration, etc. are not the meaning that limits the range of this invention only to it but only the mere examples of explanation, as long as there is no specific publication especially. Drawing 1 is drawing showing the installation situation of displacement detection dispatch ****** of the torque sensor for elastic distributor shaft couplings which is invention of the 1st of this invention, a part of (A) is the fractured side elevation, and (B) is the I-I ** view of (A). Drawing 2 is the development showing the relative position of the displacement graduation and the displacement index line containing the criteria index line of drawing 1 , and a photo detector. Drawing 3 is the schematic diagram showing the composition of the outline of the operation display circuit of the torque sensor for elastic distributor shaft couplings of the 1st method of this invention. Drawing 4 shows the wave form chart of the circuit of the frequency multiplication for raising resolution, when measuring a pulse number from the source of pulsed light in the 2nd method of this invention.

[0022] it is shown in drawing 1 -- as -- the torque sensor for elastic distributor shaft couplings of invention of the 1st of this invention -- a variation rate -- the detection dispatch means 26 and the operation display 27 -- becoming -- a variation rate -- the detecting signal detected by the detection dispatch means 26 is inputted into the operation display 27, and it is made the composition which indicates the torque and the transfer shaft power of the rotation system concerned by the operation the above and a variation rate -- the detection dispatch means 26 -- a variation rate -- a graduation 15 and a variation rate -- the index line 16, the photosensors 17 and 18 which read this graduation, and the above -- a variation rate -- it constitutes from a pillar-like lens 19 to which a graduation 15 is expanded

[0023] The index line 16 carries out formation attachment of the original working-side driving shaft 11 and the driven shaft 12 at the shape of a stamp or a sheet on the periphery front face of the original working-side distributor shaft coupling 13 which is carrying out elastic combination through the elastic member 25, and the follower side distributor shaft coupling 14. the above -- a variation rate -- a graduation 15 and a variation rate -- It constitutes so that zero graduation line 15a which is the displacement index line 16 and the criteria index line of the displacement graduation 15 as the rotation system concerned sees to drawing 1 (A) at the time of a no-load may carry out the formation position of the straight line in the periphery position of the same rotation angle of distributor shaft coupling. It carries out by the displacement index line 16 by the side of a follower making the variation rate of the rotation position carry out in the direction of a dotted-line arrow at the time of load operation, and torque is generated.

[0024] So that it may see to drawing 1 (A) and (B) the pillar-like lens 19 It prepares so that the graduation line and optical axis of the displacement graduation 15 may be located on parallel and axis X-X of the distributor shaft coupling concerned. The fragmentation graduations 19a and 19a, -- which divided into plurality a part for the glance peak of the displacement graduation expanded to the pillar side by the side of projection of this lens It prepares and the photosensor which is not illustrating plurality instead of a photosensor 17 is prepared on each fragmentation graduation. in addition, the above established on the periphery of distributor shaft couplings 13 and 14 so that two or more photosensors which the above-mentioned photosensor 17 and 18 and pillar-like lens 19 projection side prepared might be seen to drawing 2 -- a variation rate -- a graduation 15 and a variation rate -- each graduation line of the index line 16 is read certainly

[0025] Basing-on photosensor of each above-mentioned graduation read is performed at the time of load rotation, corresponding to a load, to original working-side distributor shaft coupling, it rotates with fixed delay, and the displacement graduation 15 on the original working-side distributor shaft coupling 13 precedes follower side distributor shaft coupling 14 in the direction of arrow A, and it arrives at the detection position of a photosensor 17 in this case. Namely, on the occasion of detection, reading of each graduation a photosensor 17 operates by passage of zero graduation line 15a which is the criteria index line of the displacement graduation 15, and it continues to the aforementioned zero graduation is started by the detection means in the operation display 27, and for every graduation line, the pulse of a piece is inputted into the pulse selection circuitry 31 of drawing 3 , and forms a displacement pulse train.

[0026] the delay which corresponds above "an angle of anomaly" on the other hand -- with, a variation rate -- the variation rate according to the aforementioned photosensor 17 at the pulse selection circuitry 31 of drawing 3 by the output of the photosensor 18 in which the index line 16 moved in the direction of arrow B, reached the lower part of a photosensor 18, and read this graduation 16 -- the read of a graduation 15, i.e., a variation rate, -- the formation is stopped in the place in which the pulse train formed the "angle of anomaly"

[0027] subsequently, the read start of a photosensor 17 -- reading -- the above to a halt -- a variation rate -- the variation rate applicable to each graduation of a graduation -- torque calculates in the torque arithmetic circuit 32 by the "angle of anomaly" which is the total of a pulse number It is desirable to be able to perform the operation of the above-mentioned torque repeatedly for every rotation, to make this memorize, and to set up the average as formal torque of the rotation system concerned. The calculated torque is inputted into the shaft-power arithmetic circuit 35 through the distribution circuit 33. On the other hand, the number of passage read of the displacement index line 16 per [which was detected by the photosensor 18 in this circuit 35] unit time is inputted as a rotational frequency, and calculates a shaft power by the product of the aforementioned torque and a rotational frequency in the aforementioned shaft-power arithmetic circuit 35. Subsequently, the above-mentioned operation value is inputted into the torque drop 34 and the shaft-power drop 36, respectively, and an indication is given possible.

[0028] In addition, when the above and the pillar-like lens 19 are formed Fragmentation graduation 19a which divided into plurality a part for the glance peak of the displacement graduation which each graduation interval of the displacement graduation 15 was expanded, and was expanded to the pillar side by the side of projection of the aforementioned lens, 19a, -- It is what prepares and prepared the photosensor which is not illustrating plurality instead of a photosensor 17 on each fragmentation graduation, and resolution can be raised.

[0029] Drawing 4 is an example of the easy frequency-multiplication circuit used in order to raise resolution, when measuring the pulse number from the source of pulsed light and asking for a relative angle of anomaly, and is drawing showing the wave. (A) is the fundamental-wave form of the minimum graduation angle which reads the angle of 1 graduation and can be

discriminated, and had conversion of waveform performed to the square wave of a period T, as shown in drawing. Next, it becomes the wave which shows a differential circuit to the thing which made it pass, then (B) about this, and if a rectifier circuit is passed further, it will become the wave shown in (C). If this compares with the wave shown in (A), it will mean that the period is multiplied to one half, frequency is multiplied to double precision, and multiplication conversion of a pulse was performed clearly. In this case, if this is used, it will mean that resolution was raised to double precision on the electrical circuit.

[0030] It corresponds, when the thing which twisted between distributor shaft couplings shown in drawing 5 (A), and inserted the coil spring, or the torsion bar spring which shows in this drawing (B) in the case of the driveshaft of a vessel is inserted, and all can use the torque sensor for elastic distributor shaft couplings which is the 1st method of this invention for distributor shaft coupling without hysteresis, as long as the installation position of a displacement graduation and a criteria graduation is performed correctly, even when between distributor shaft couplings is separated.

[0031] Moreover, static output-torque calibration value can be calculated by adding a dummy load to a follower side.

[0032]

[Effect of the Invention] By the above-mentioned composition of this invention, without being accompanied by change of a internal structure and an installation position to established elastic distributor shaft coupling, it can attach easily, the relative angle of anomaly of two shafts by the load can be measured correctly easily, therefore the torque of the rotation system concerned and the operation display of a transfer shaft power can be performed. Moreover, proofreading of the static output torque is possible.

CLAIMS

[Claim(s)]

[Claim 1] In the torque sensor which detects the displacement angle of the relative position of distributor shaft coupling in which a hook property carries out elastic combination, and indicates torque and the transfer shaft power by the operation The displacement graduation which follows original working-side distributor shaft coupling at the time of a no-load at the criteria index line which is a zero graduation line, and it is formed. The original working-side sensor which prepared the displacement index line in the installation position of the aforementioned criteria index line at follower side distributor shaft coupling, and was formed in the upper part of the index line of these two groups, respectively, The displacement-angle detection dispatch means considered as the composition containing a follower side sensor, and a displacement-angle detection means to control the graduation read of the aforementioned field working-side sensor and a follower side sensor, and to detect a displacement angle, The torque sensor for elastic distributor shaft couplings characterized by what was constituted from an operation display which calculates torque and a transfer shaft power with a detection value.

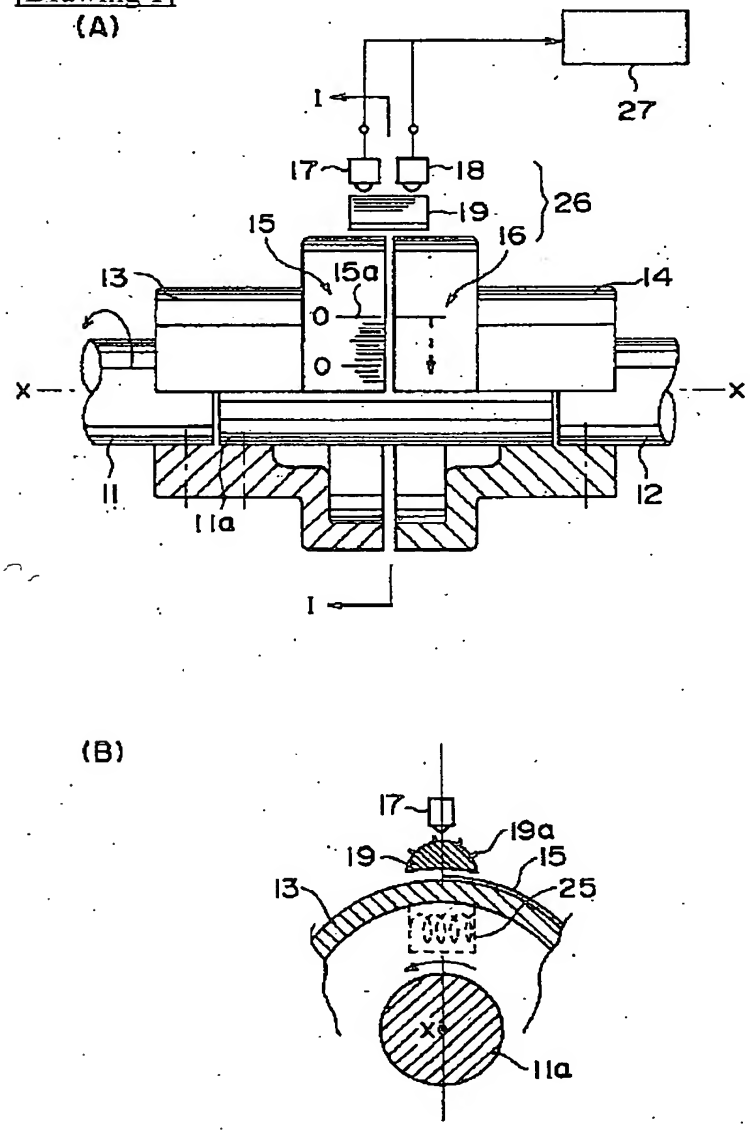
[Claim 2] the variation rate to which the aforementioned detection means follows this criteria index line with the read of criteria index-line passage of a original ** side sensor -- the variation rate start the read of a graduation and according to a follower side sensor -- the torque sensor for elastic distributor shaft couplings according to claim 1 characterized by what was considered as the composition which stops the read of a original ** side sensor by the read of passage of the index line

[Claim 3] The aforementioned field working-side sensor is a torque sensor for elastic distributor shaft couplings according to claim 1 characterized by what two or more fragmentation graduations were formed in the projection side of a pillar-like lens, two or more individual sensors which read this fragmentation graduation were formed on each subdivided

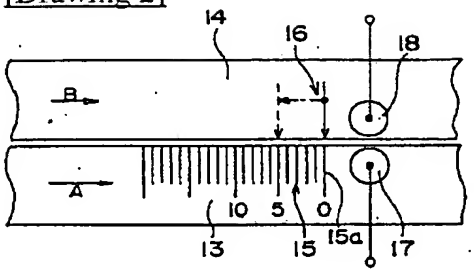
graduation line, and the resolution-enhancement sensor was constituted for.
[Claim 4] The aforementioned sensor is minimum graduation angle thetamin which a sensor reads 1 graduation and can discriminate during rotation, or its radii length Lmin. It receives. The pulse frequency which sets the rate of division of 1 graduation to 1/sigma is generated on an electrical circuit, and it considers as the source of pulsed light of a sensor. the aforementioned displacement-angle detection means Irradiate two, the criteria index line on distributor shaft coupling, and the displacement index line, and a photo detector starts the read of a pulse by the criteria index line for every rotation. The torque sensor for elastic distributor shaft couplings according to claim 1 characterized by what the read was stopped by the displacement index line, and was considered as the composition which detects the relative angle of anomaly or radii length of two shafts which resolution sigma Doubled from the pulse number in which the photo detector read the pulse from the light source in the meantime.

DRAWINGS

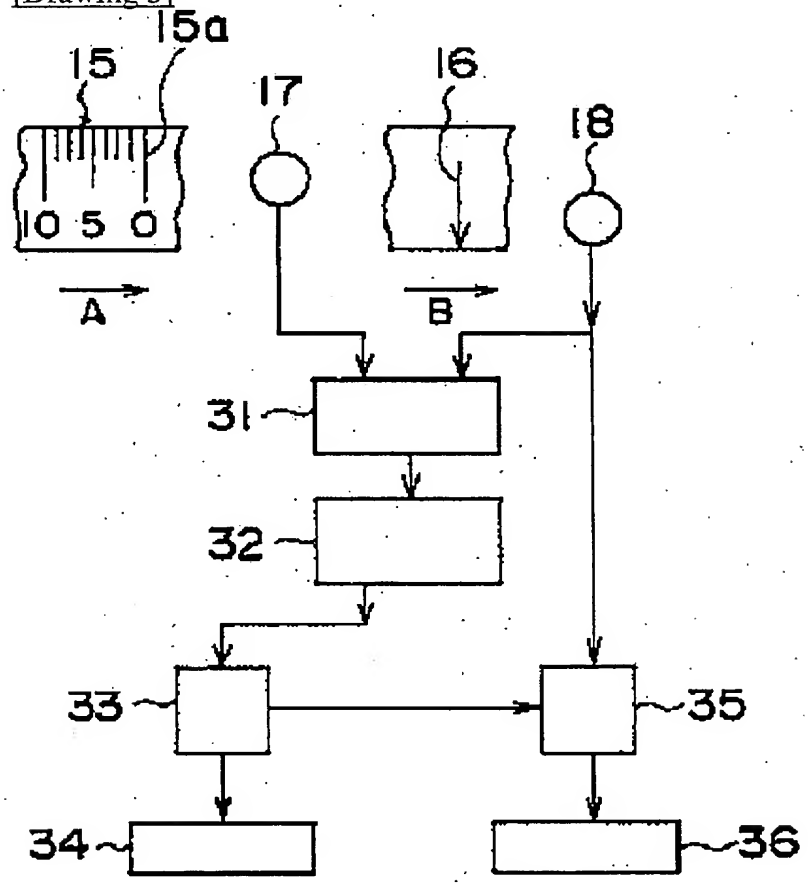
[Drawing 1]



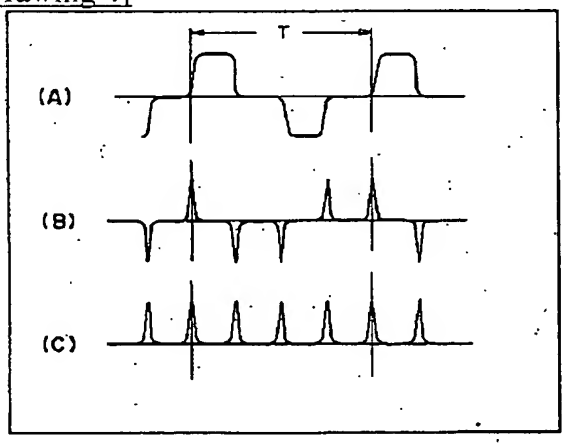
[Drawing 2]



[Drawing 3]

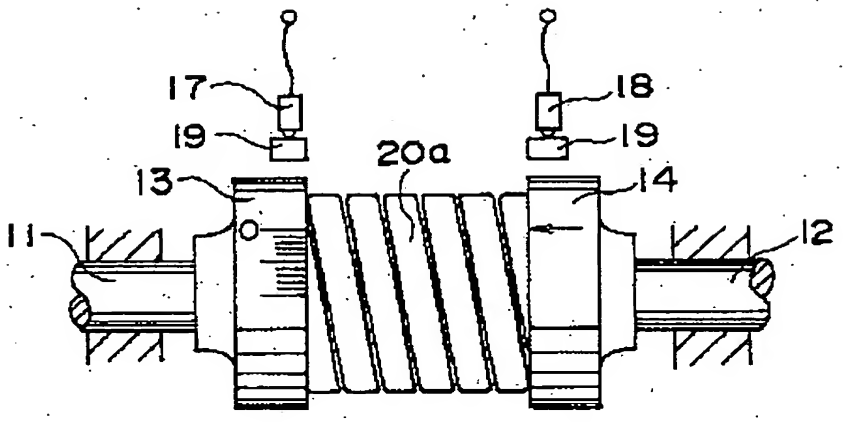
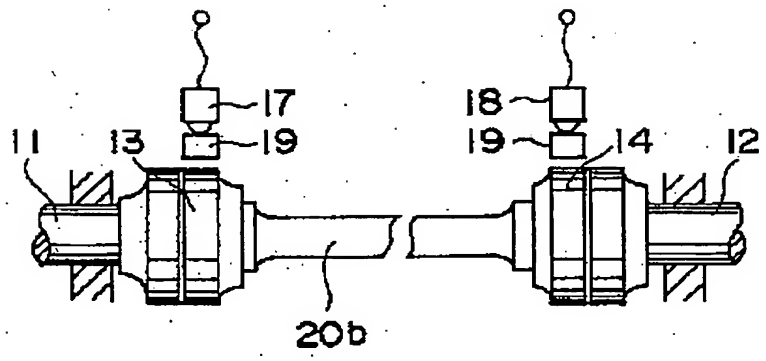


[Drawing 4]



[Drawing 5]

(A)



(B)